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Kurihara

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(54) **PRINTING APPARATUS, CONTROL METHOD FOR THE PRINTING APPARATUS, AND STORAGE MEDIUM**

(75) Inventor: **Shukei Kurihara**, Yokohama (JP)

(73) Assignee: **Canon Kabushiki Kaisha**, Tokyo (JP)

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G03G 21/16	(2006.01)
G03G 15/01	(2006.01)
G03G 15/08	(2006.01)
G06F 3/12	(2006.01)

(52) **U.S. Cl.**

CPC ***G03G 15/0173*** (2013.01); ***G03G 15/556*** (2013.01); ***G03G 21/1633*** (2013.01); *G03G 2215/0116* (2013.01); ***G03G 15/0865*** (2013.01)
USPC **358/1.14**; 358/1.15

(58) **Field of Classification Search**

CPC G06G 15/0173; G06G 15/0865; G06G 2215/0116
See application file for complete search history.

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Primary Examiner — Dov Popovici
(74) *Attorney, Agent, or Firm* — Canon U.S.A., Inc. IP Division

(57) **ABSTRACT**

A printing apparatus configured to perform printing by using a recording material, includes a storing unit configured to store a recording material, a moving unit configured to move the storing unit determined to have run out of a recording material to a position where a recording material is supplied to the printing apparatus, and a setting unit configured to, according to an instruction from a user, set continued use of the storing unit determined to have run out of the recording material. The moving unit does not move the storing unit to the position even when the storing unit is determined to have run out of the recording material if continued use of the storing unit determined to have run out of the recording material is set.

17 Claims, 13 Drawing Sheets

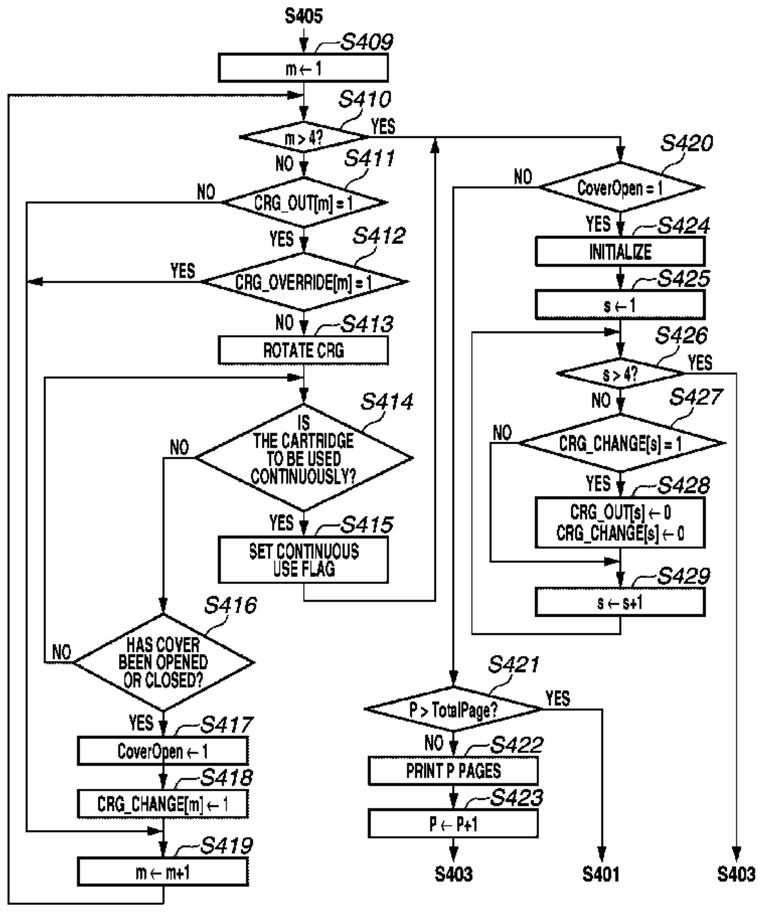


FIG.1

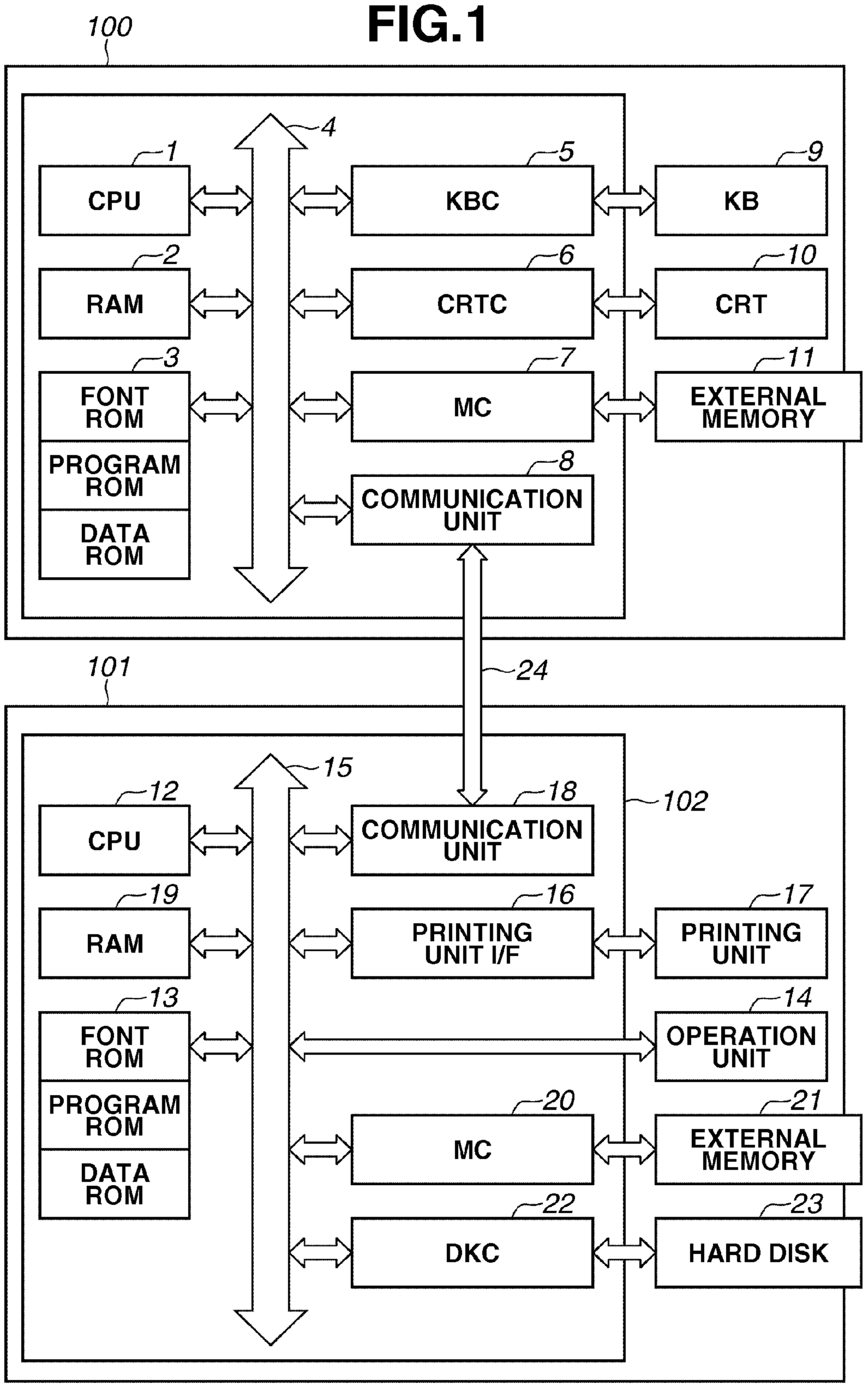

100
4
1
CPU
5
KBC
9
KB
2
RAM
6
CRTC
10
CRT
3
FONT ROM
PROGRAM ROM
DATA ROM
7
MC
11
EXTERNAL MEMORY
8
COMMUNICATION UNIT
24
101
15
12
CPU
18
COMMUNICATION UNIT
102
19
RAM
16
PRINTING UNIT I/F
17
PRINTING UNIT
13
FONT ROM
PROGRAM ROM
DATA ROM
14
OPERATION UNIT
20
MC
21
EXTERNAL MEMORY
22
DKC
23
HARD DISK

FIG.2

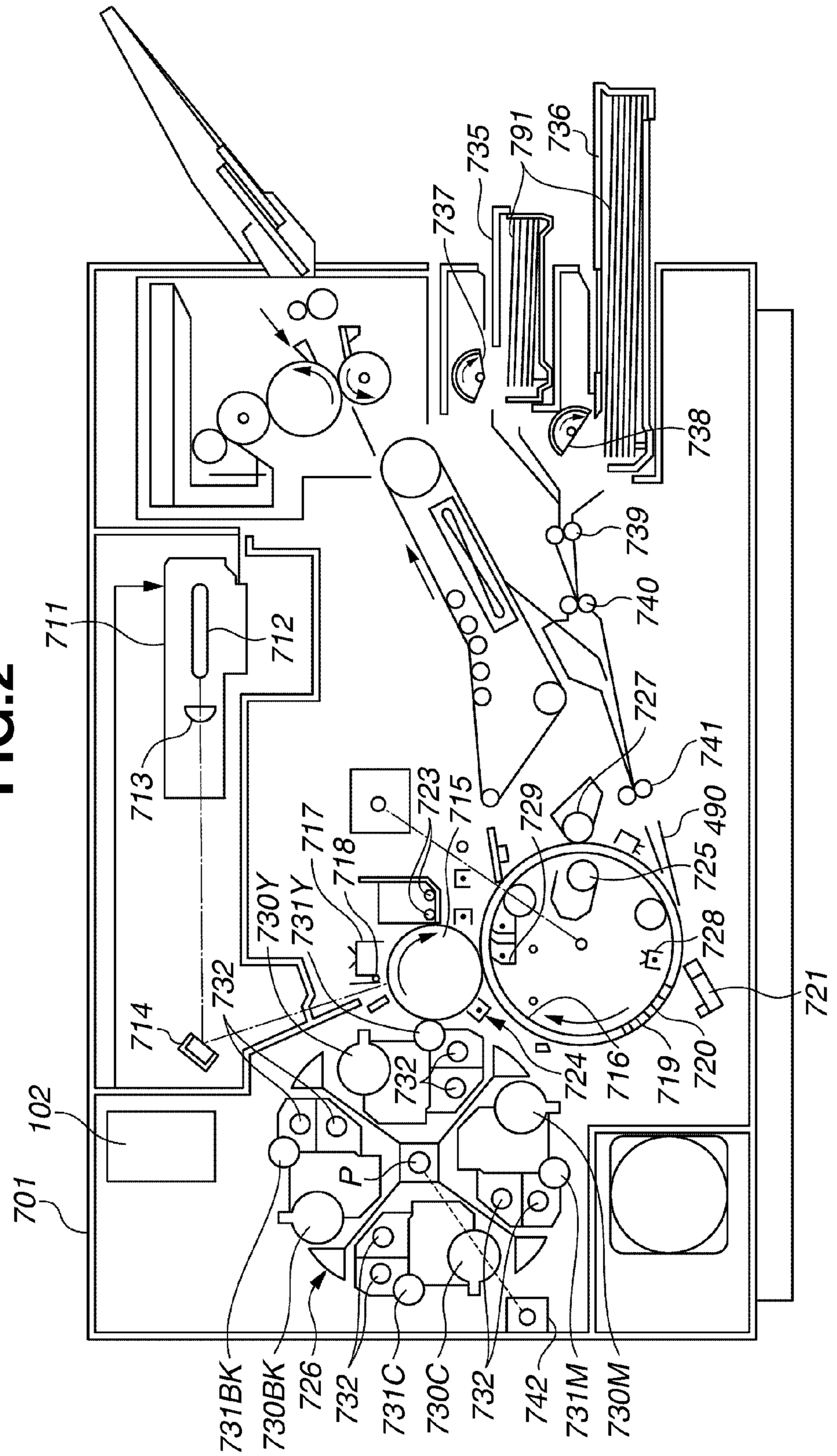

737
735
791
736
738
739
740
727
741
490
725
728
721
711
712
713
723
715
729
717
718
730Y
731Y
732
714
724
716
719
720
102
701
P
731BK
730BK
726
732
731C
730C
732
742
731M
730M

FIG.3

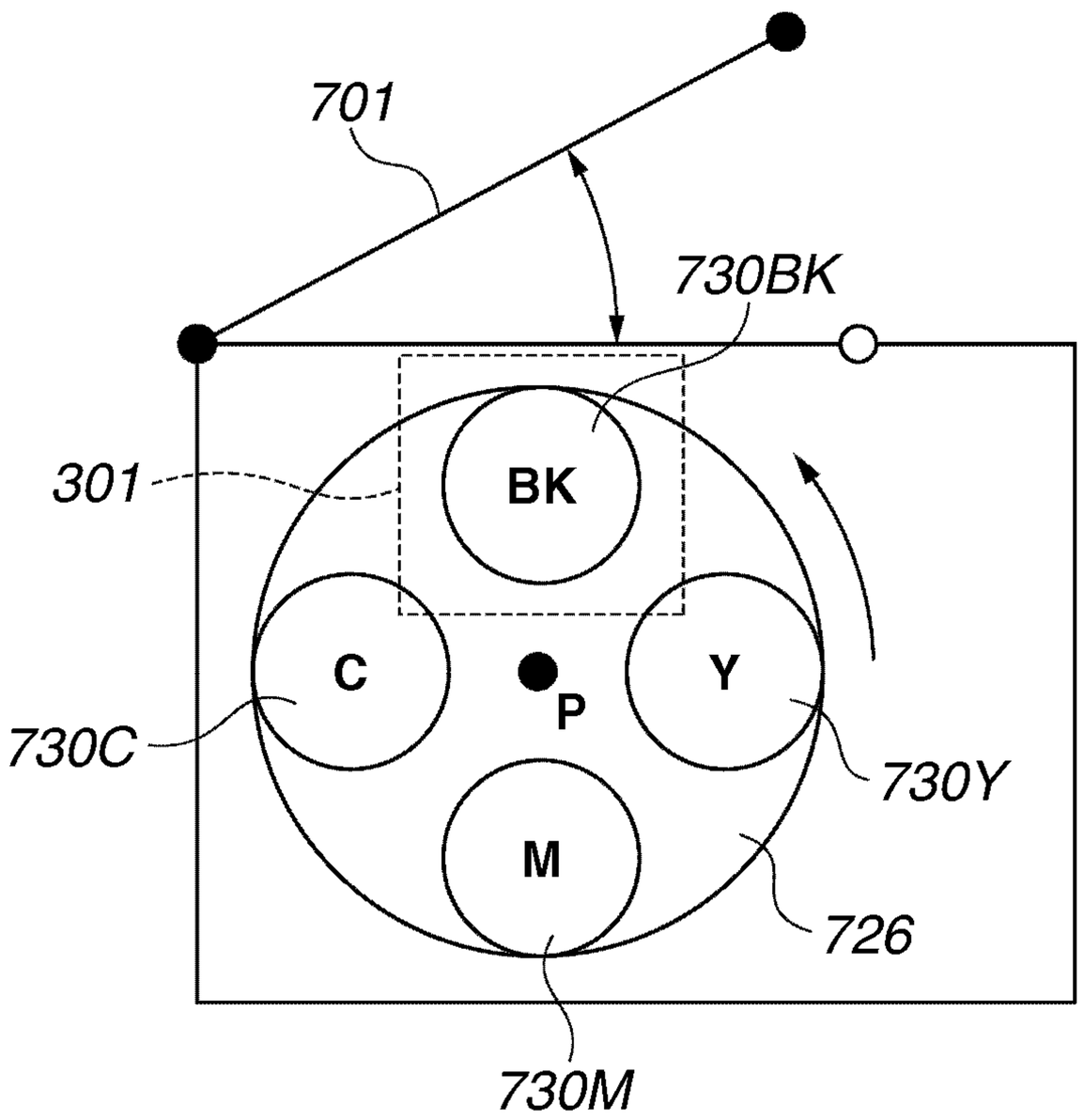


FIG.4

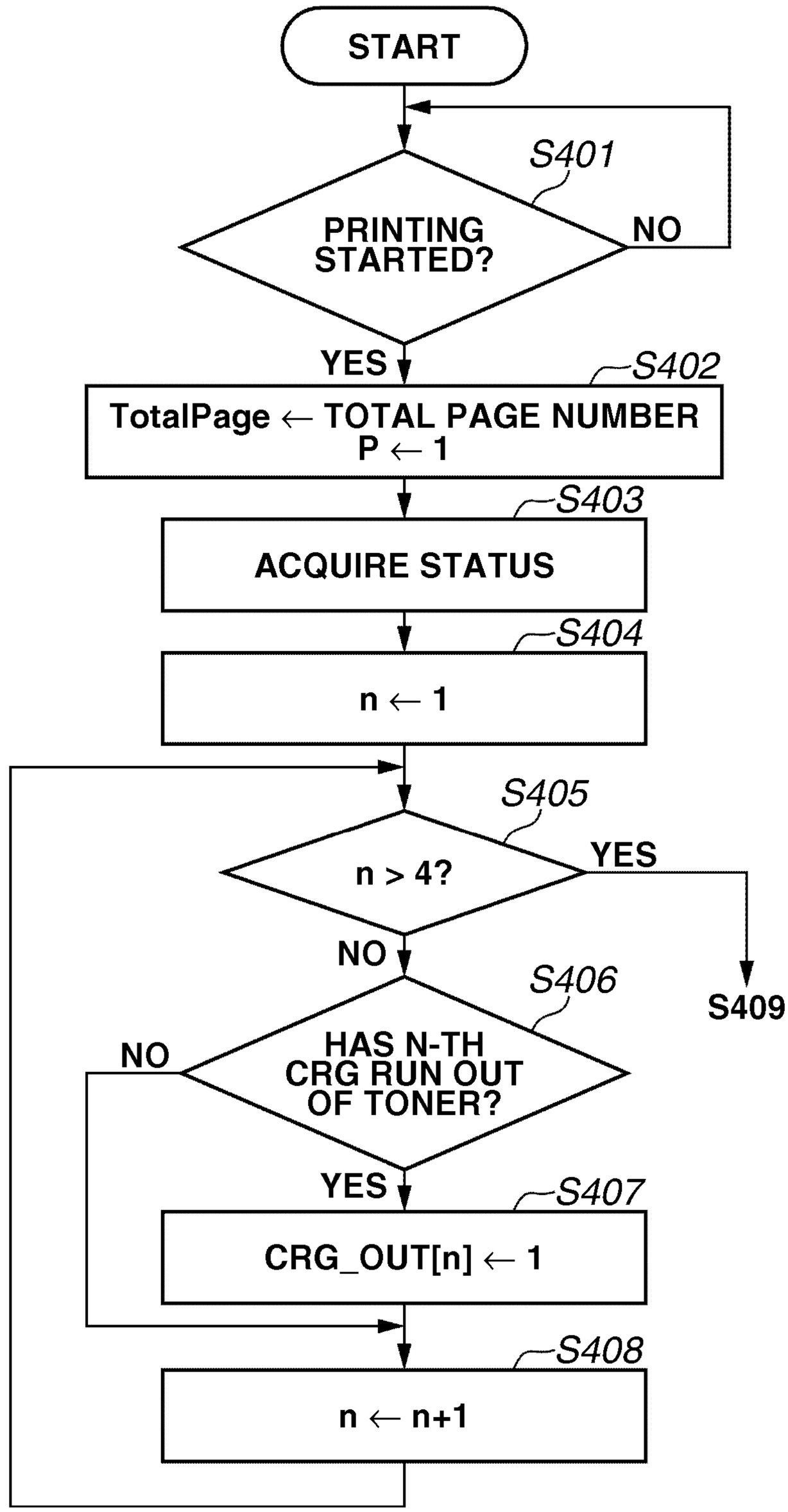

START
S401
PRINTING STARTED?
NO
YES
S402
TotalPage ← TOTAL PAGE NUMBER
P ← 1
S403
ACQUIRE STATUS
S404
n ← 1
S405
n > 4?
YES
NO
S406
HAS N-TH CRG RUN OUT OF TONER?
NO
YES
S407
CRG_OUT[n] ← 1
S408
n ← n+1
S409

FIG.5

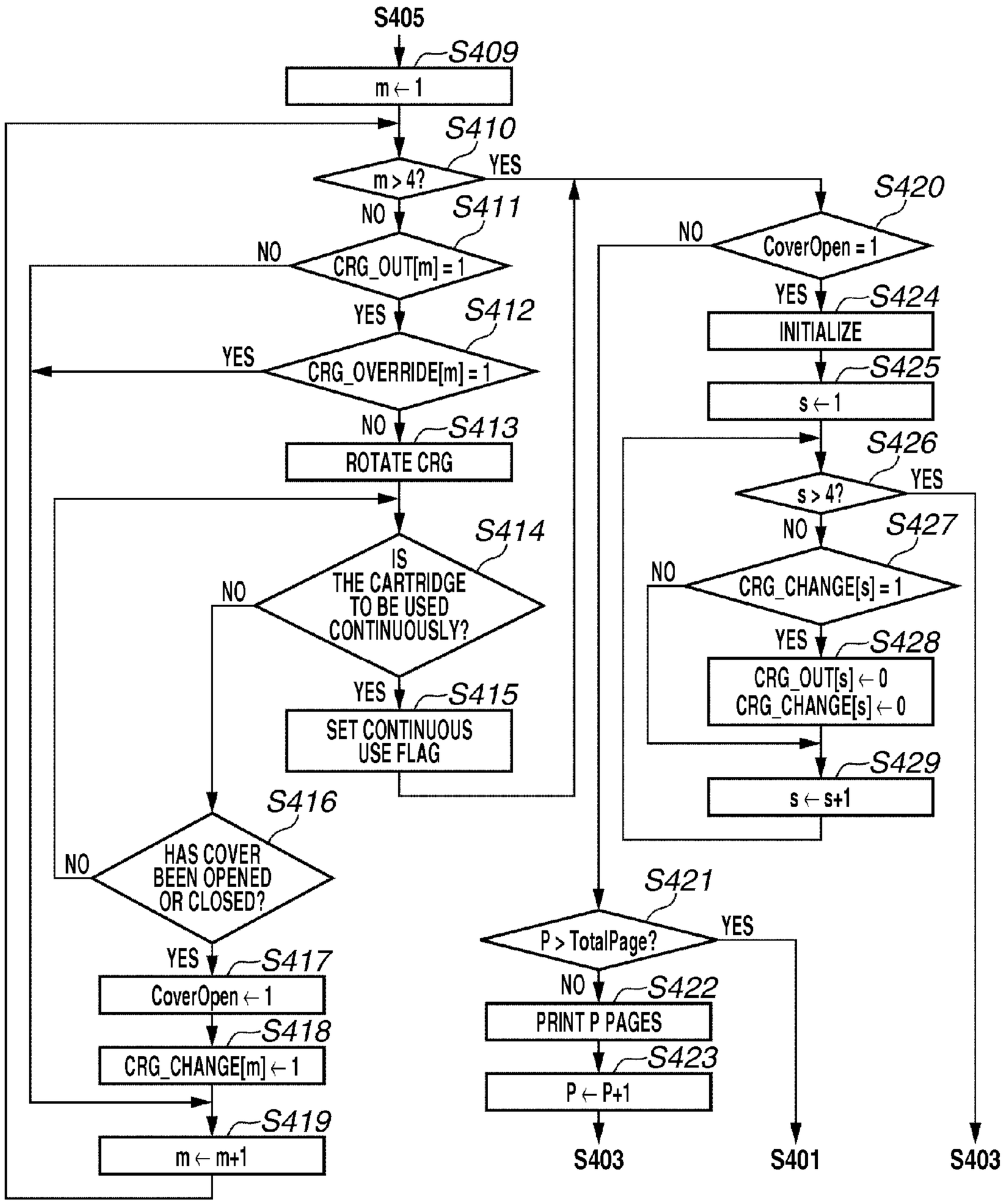

S405
S409
m←1
S410
m > 4?
YES
NO
S411
CRG_OUT[m] = 1
NO
YES
S412
CRG_OVERRIDE[m] = 1
YES
NO
S413
ROTATE CRG
S414
IS THE CARTRIDGE TO BE USED CONTINUOUSLY?
NO
YES
S415
SET CONTINUOUS USE FLAG
S416
HAS COVER BEEN OPENED OR CLOSED?
NO
YES
S417
CoverOpen ← 1
S418
CRG_CHANGE[m] ← 1
S419
m ← m+1
S420
CoverOpen = 1
NO
YES
S424
INITIALIZE
S425
s ← 1
S426
s > 4?
YES
NO
S427
CRG_CHANGE[s] = 1
NO
YES
S428
CRG_OUT[s] ← 0
CRG_CHANGE[s] ← 0
S429
s ← s+1
S421
P > TotalPage?
YES
NO
S422
PRINT P PAGES
S423
P ← P+1
S403
S401
S403

FIG.6

VARIABLES	VALUE	DESCRIPTION OF VARIABLES
TotalPage	10	VARIABLE INDICATING TOTAL NUMBER OF PAGES TO BE PRINTED
P	1	VARIABLE INDICATING PAGE NUMBER UNDER PROCESSING
CoverOpen	0	VARIABLE INDICATING WHETHER COVER HAS BEEN OPENED OR CLOSED
CRG_OUT[1]	0	TONER OUT FLAG FOR TONER CARTRIDGE 730C
CRG_OUT[2]	0	TONER OUT FLAG FOR TONER CARTRIDGE 730M
CRG_OUT[3]	0	TONER OUT FLAG FOR TONER CARTRIDGE 730Y
CRG_OUT[4]	0	TONER OUT FLAG FOR TONER CARTRIDGE 730BK
CRG_OVERRIDE [1]	0	CONTINUED USE FLAG FOR TONER CARTRIDGE 730C
CRG_OVERRIDE [2]	0	CONTINUED USE FLAG FOR TONER CARTRIDGE 730M
CRG_OVERRIDE [3]	0	CONTINUED USE FLAG FOR TONER CARTRIDGE 730Y
CRG_OVERRIDE [4]	0	CONTINUED USE FLAG FOR TONER CARTRIDGE 730BK
CRG_CHANGE [1]	0	VARIABLE INDICATING WHETHER TONER CARTRIDGE 730C HAS BEEN REPLACED
CRG_CHANGE [2]	0	VARIABLE INDICATING WHETHER TONER CARTRIDGE 730M HAS BEEN REPLACED
CRG_CHANGE [3]	0	VARIABLE INDICATING WHETHER TONER CARTRIDGE 730Y HAS BEEN REPLACED
CRG_CHANGE [4]	0	VARIABLE INDICATING WHETHER TONER CARTRIDGE 730BK HAS BEEN REPLACED

FIG.7

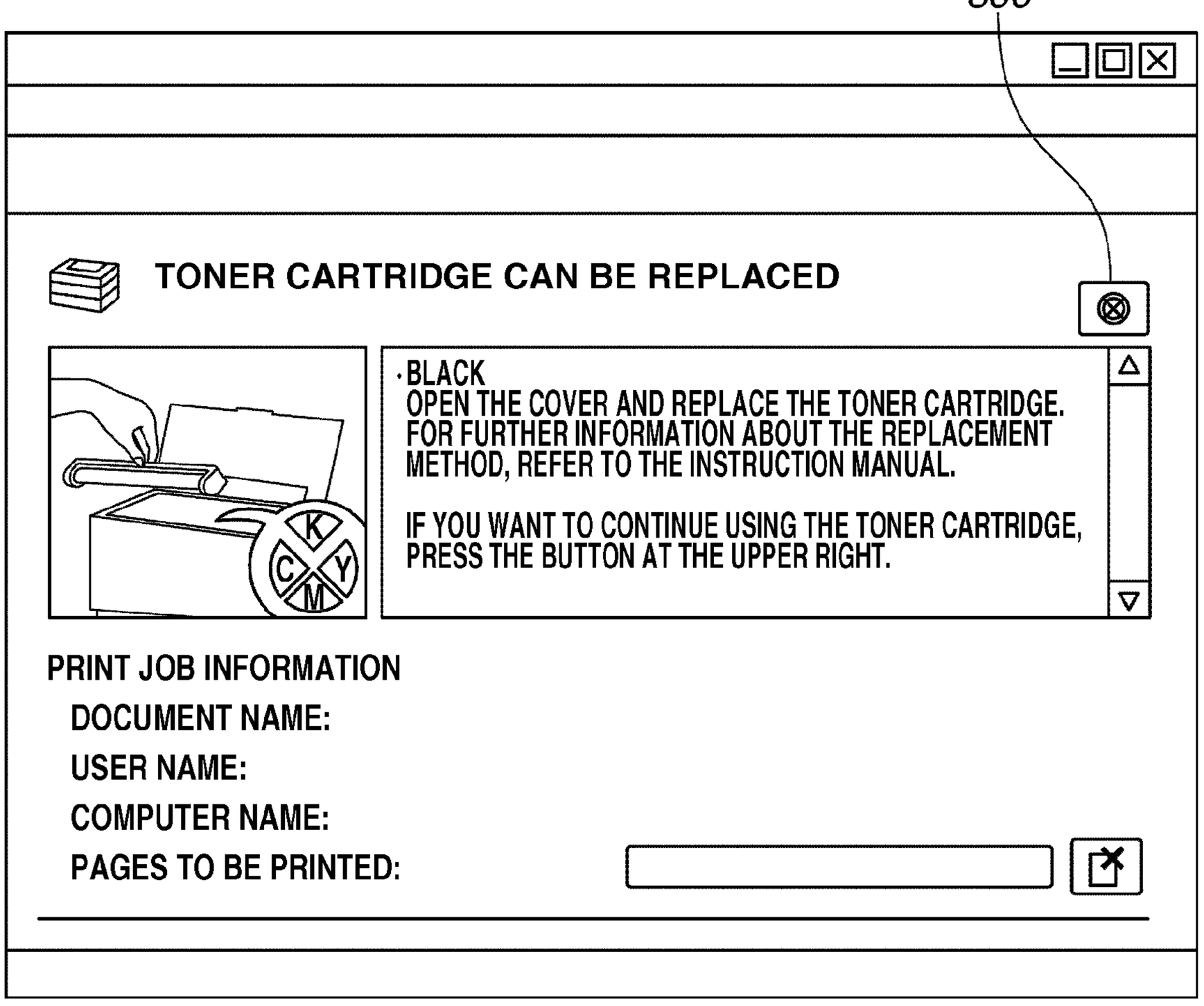

800
TONER CARTRIDGE CAN BE REPLACED
K
C
Y
M
· BLACK
OPEN THE COVER AND REPLACE THE TONER CARTRIDGE.
FOR FURTHER INFORMATION ABOUT THE REPLACEMENT METHOD, REFER TO THE INSTRUCTION MANUAL.
IF YOU WANT TO CONTINUE USING THE TONER CARTRIDGE, PRESS THE BUTTON AT THE UPPER RIGHT.
PRINT JOB INFORMATION
DOCUMENT NAME:
USER NAME:
COMPUTER NAME:
PAGES TO BE PRINTED:

FIG.8

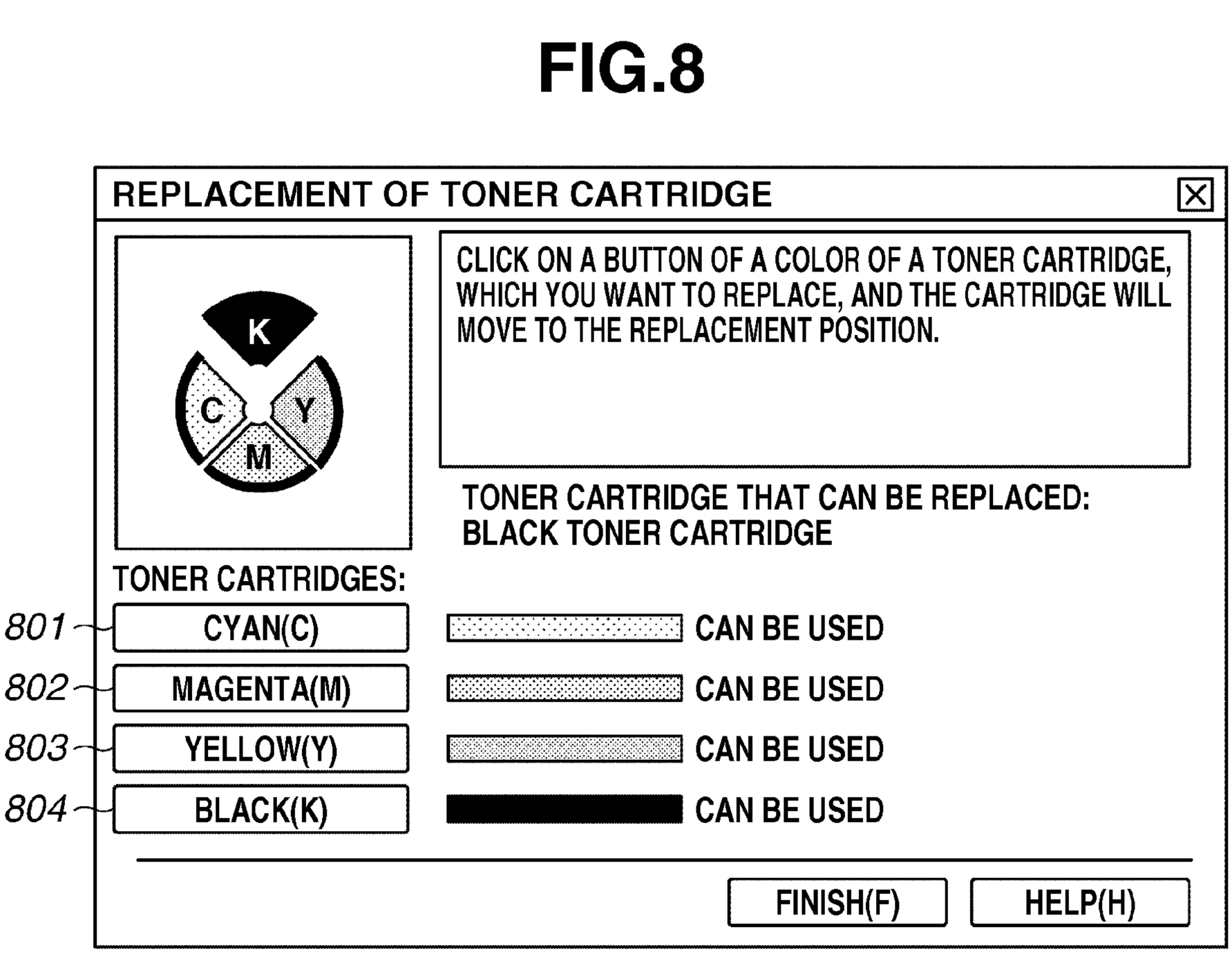

REPLACEMENT OF TONER CARTRIDGE
K
C
Y
M
CLICK ON A BUTTON OF A COLOR OF A TONER CARTRIDGE, WHICH YOU WANT TO REPLACE, AND THE CARTRIDGE WILL MOVE TO THE REPLACEMENT POSITION.
TONER CARTRIDGE THAT CAN BE REPLACED:
BLACK TONER CARTRIDGE
TONER CARTRIDGES:
801
CYAN(C)
CAN BE USED
802
MAGENTA(M)
CAN BE USED
803
YELLOW(Y)
CAN BE USED
804
BLACK(K)
CAN BE USED
FINISH(F)
HELP(H)

FIG.9

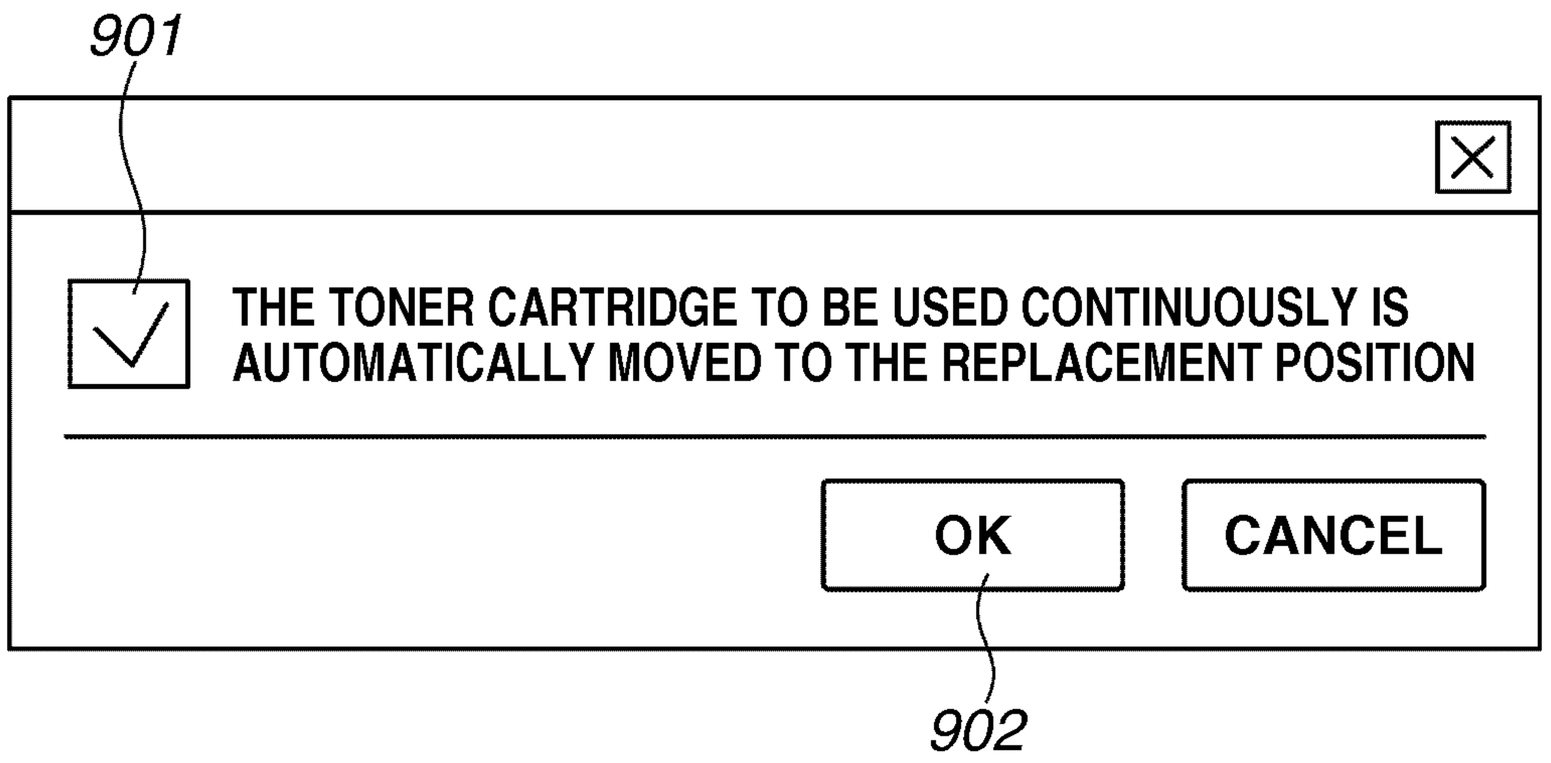

901
THE TONER CARTRIDGE TO BE USED CONTINUOUSLY IS AUTOMATICALLY MOVED TO THE REPLACEMENT POSITION
OK
CANCEL
902

FIG.10

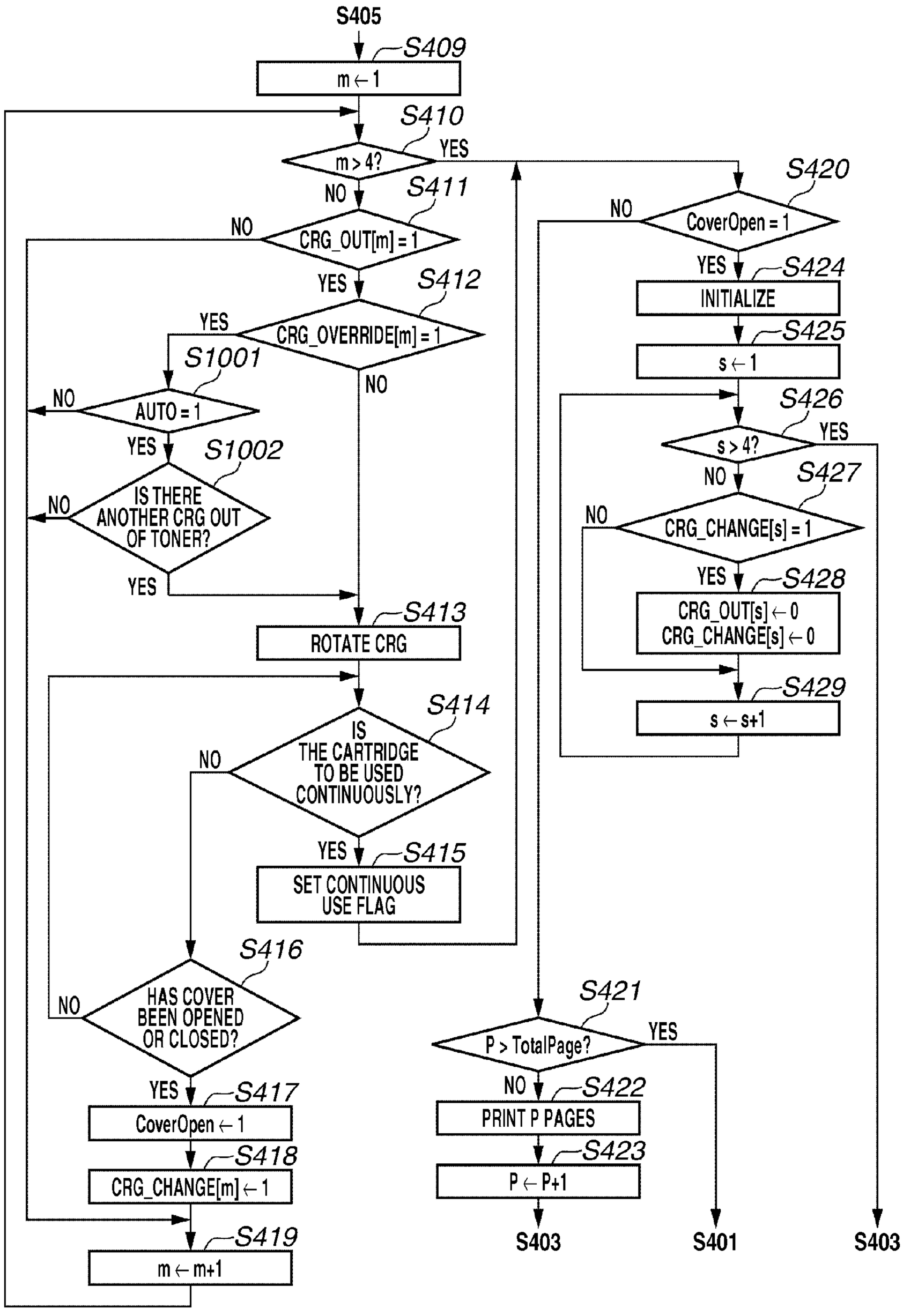

S405
S409
m ← 1
S410
m > 4?
YES
NO
S411
CRG_OUT[m] = 1
NO
YES
S412
CRG_OVERRIDE[m] = 1
YES
NO
S1001
AUTO = 1
NO
YES
S1002
IS THERE ANOTHER CRG OUT OF TONER?
NO
YES
S413
ROTATE CRG
S414
IS THE CARTRIDGE TO BE USED CONTINUOUSLY?
NO
YES
S415
SET CONTINUOUS USE FLAG
S416
HAS COVER BEEN OPENED OR CLOSED?
NO
YES
S417
CoverOpen ← 1
S418
CRG_CHANGE[m] ← 1
S419
m ← m+1
S420
CoverOpen = 1
NO
YES
S424
INITIALIZE
S425
s ← 1
S426
s > 4?
YES
NO
S427
CRG_CHANGE[s] = 1
NO
YES
S428
CRG_OUT[s] ← 0
CRG_CHANGE[s] ← 0
S429
s ← s+1
S421
P > TotalPage?
YES
NO
S422
PRINT P PAGES
S423
P ← P+1
S403
S401
S403

FIG.11

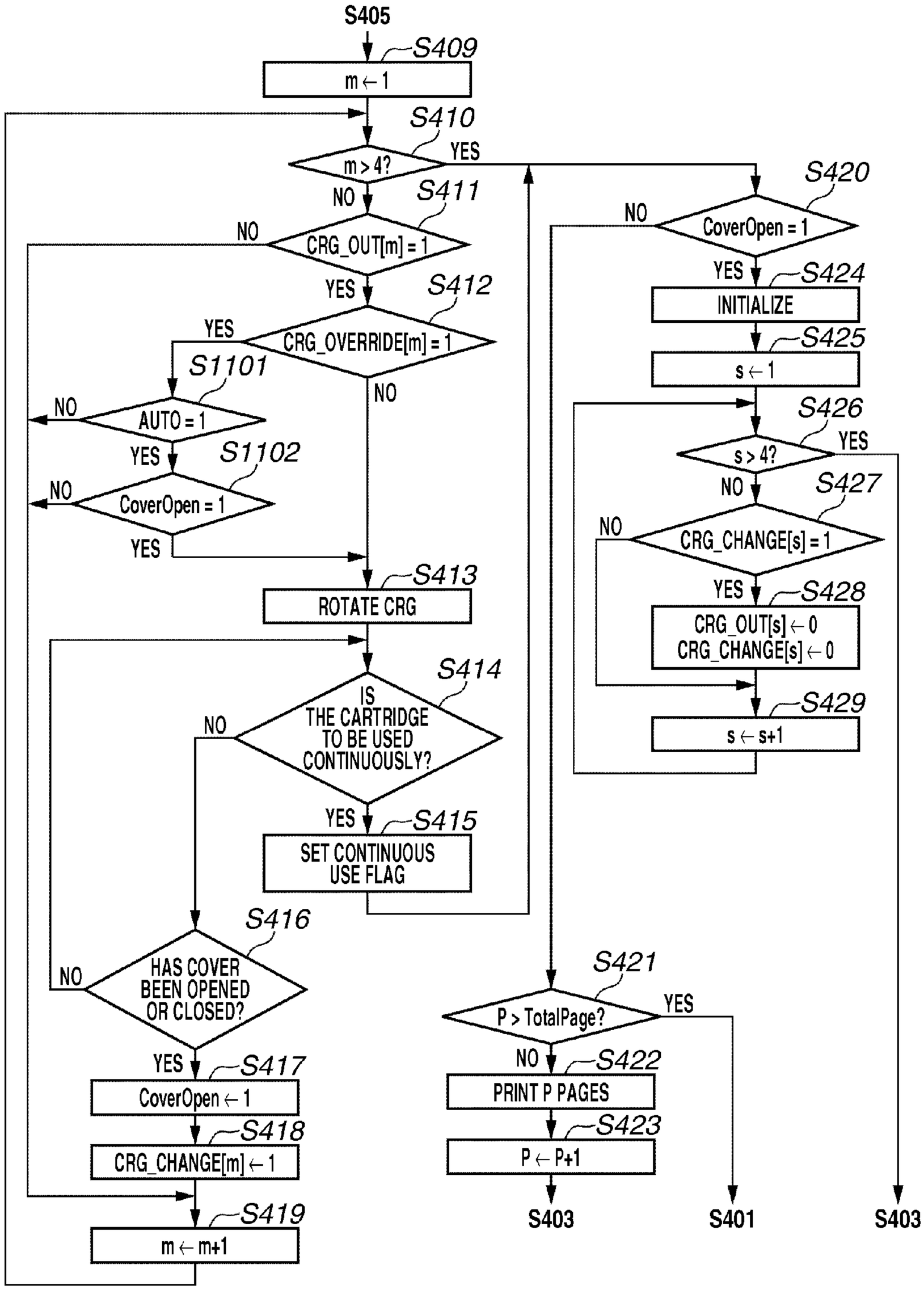
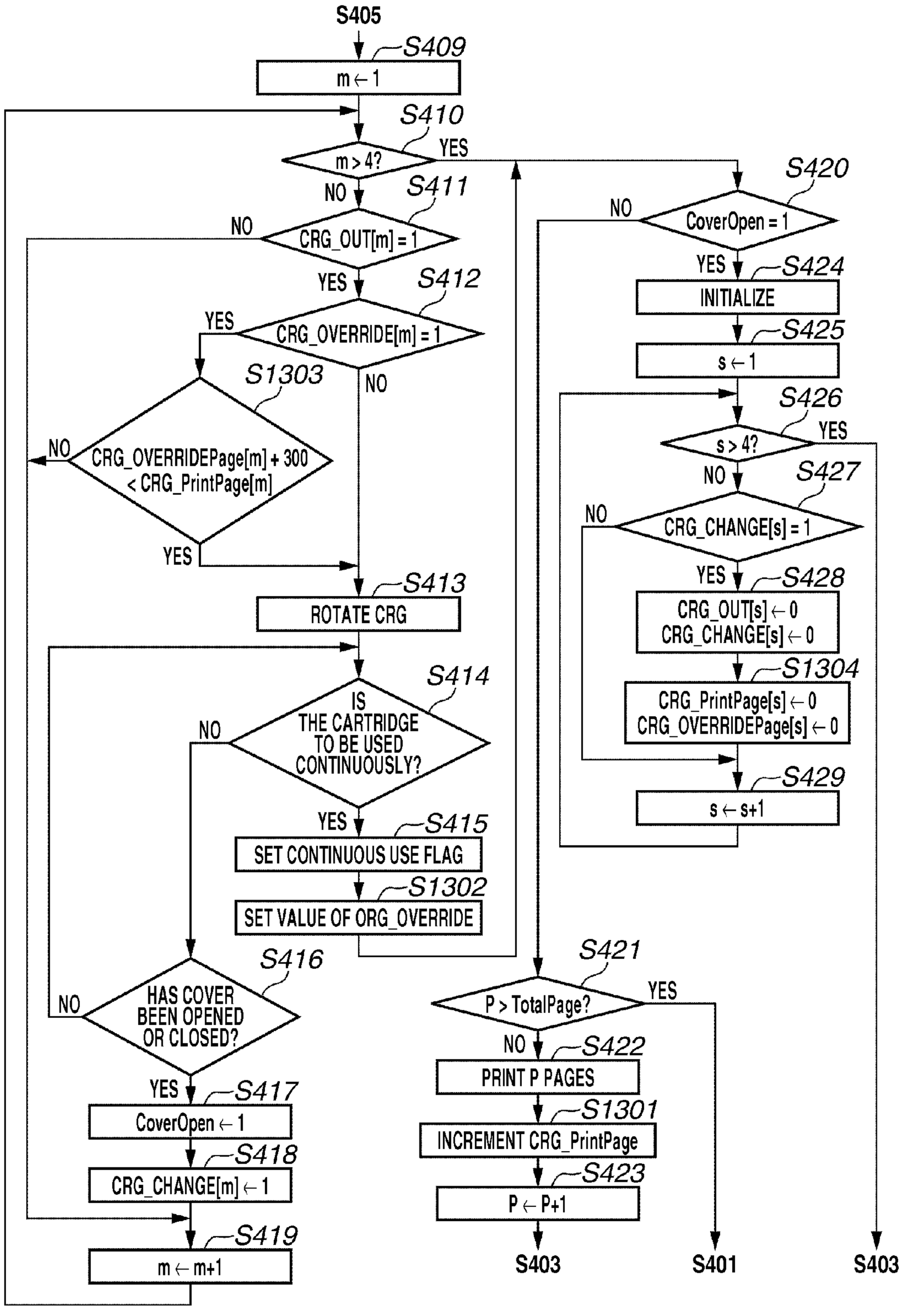

S405
S409
m ← 1
S410
m > 4?
YES
NO
S411
CRG_OUT[m] = 1
NO
YES
S412
CRG_OVERRIDE[m] = 1
YES
NO
S1101
AUTO = 1
NO
YES
S1102
CoverOpen = 1
NO
YES
S413
ROTATE CRG
S414
IS THE CARTRIDGE TO BE USED CONTINUOUSLY?
NO
YES
S415
SET CONTINUOUS USE FLAG
S416
HAS COVER BEEN OPENED OR CLOSED?
NO
YES
S417
CoverOpen ← 1
S418
CRG_CHANGE[m] ← 1
S419
m ← m+1
S420
CoverOpen = 1
NO
YES
S424
INITIALIZE
S425
s ← 1
S426
s > 4?
YES
NO
S427
CRG_CHANGE[s] = 1
NO
YES
S428
CRG_OUT[s] ← 0
CRG_CHANGE[s] ← 0
S429
s ← s+1
S421
P > TotalPage?
YES
NO
S422
PRINT P PAGES
S423
P ← P+1
S403
S401
S403

FIG.12

VARIABLE	VALUE	DESCRIPTION OF VARIABLES
CRG_PrintPage[1]	100	NUMBER OF PAGES PRINTED USING TONER CARTRIDGE 730C
CRG_PrintPage[2]	100	NUMBER OF PAGES PRINTED USING TONER CARTRIDGE 730M
CRG_PrintPage[3]	100	NUMBER OF PAGES PRINTED USING TONER CARTRIDGE 730Y
CRG_PrintPage[4]	200	NUMBER OF PAGES PRINTED USING TONER CARTRIDGE 730BK
CRG_OVERRIDEPage[1]	0	NUMBER OF PAGES PRINTED WHEN CONTINUED USE OF TONER CARTRIDGE 730C IS SPECIFIED
CRG_OVERRIDEPage[2]	0	NUMBER OF PAGES PRINTED WHEN CONTINUED USE OF TONER CARTRIDGE 730M IS SPECIFIED
CRG_OVERRIDEPage[3]	0	NUMBER OF PAGES PRINTED WHEN CONTINUED USE OF TONER CARTRIDGE 730Y IS SPECIFIED
CRG_OVERRIDEPage[4]	150	NUMBER OF PAGES PRINTED WHEN CONTINUED USE OF TONER CARTRIDGE 730BK IS SPECIFIED

FIG.13


S405
S409
m ← 1
S410
m > 4?
YES
NO
S411
CRG_OUT[m] = 1
NO
YES
S412
CRG_OVERRIDE[m] = 1
YES
NO
S1303
CRG_OVERRIDEPage[m] + 300 < CRG_PrintPage[m]
NO
YES
S413
ROTATE CRG
S414
IS THE CARTRIDGE TO BE USED CONTINUOUSLY?
NO
YES
S415
SET CONTINUOUS USE FLAG
S1302
SET VALUE OF ORG_OVERRIDE
S416
HAS COVER BEEN OPENED OR CLOSED?
NO
YES
S417
CoverOpen ← 1
S418
CRG_CHANGE[m] ← 1
S419
m ← m+1
S420
CoverOpen = 1
NO
YES
S424
INITIALIZE
S425
s ← 1
S426
s > 4?
YES
NO
S427
CRG_CHANGE[s] = 1
NO
YES
S428
CRG_OUT[s] ← 0
CRG_CHANGE[s] ← 0
S1304
CRG_PrintPage[s] ← 0
CRG_OVERRIDEPage[s] ← 0
S429
s ← s+1
S421
P > TotalPage?
YES
NO
S422
PRINT P PAGES
S1301
INCREMENT CRG_PrintPage
S423
P ← P+1
S403
S401
S403

PRINTING APPARATUS, CONTROL METHOD FOR THE PRINTING APPARATUS, AND STORAGE MEDIUM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a printing apparatus including a storing unit for storing a recording material, and configured to perform printing by using the recording material.

2. Description of the Related Art

In a printing apparatus which rotates a plurality of toner cartridges, when some toner cartridge has run out of toner, this toner cartridge is moved to a position where the user can replace the toner cartridge as discussed in Japanese Patent Application Laid-Open No. 2003-323027.

To move a toner-out cartridge to a position where it can be replaced, the printing apparatus needs to detect a toner-out cartridge. For example, an optical sensor is used to detect remaining amount of toner in a toner cartridge, and when a cartridge that has run out of toner is detected, the cartridge is moved to its replacement position. Thus, the user can replace the toner cartridge smoothly.

However, if the accuracy of the optical sensor is insufficient, even if a toner cartridge in a toner-out state is detected, some amount of toner often remains in the cartridge enough to print a few pages. There may be some users who still want to use the toner until just before the printed characters are so thin and blurred.

Despite the fact that the user still wants to keep using the toner cartridge that is determined to be empty, if the user have to move the toner cartridge to the replacement position each time the printing apparatus has determined that the toner cartridge is out of recording material, this is inconvenient for users.

SUMMARY OF THE INVENTION

According to an aspect of the present invention, a printing apparatus configured to perform printing by using a recording material, includes a storing unit configured to store a recording material, a moving unit configured to move a storing unit determined to have run out of a recording material to a position where a recording material is supplied to the printing apparatus, and a setting unit configured to, according to an instruction from a user, set continued use of the storing unit determined to have run out of the recording material, wherein the moving unit does not move the storing unit to the position even when the storing unit is determined to have run out of the recording material if continued use of the storing unit determined to have run out of the recording material is set.

Further features and aspects of the present invention will become apparent from the following detailed description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate exemplary embodiments, features, and aspects of the invention and, together with the description, serve to explain the principles of the invention.

FIG. **1** is a block diagram illustrating a printing system according to a first exemplary embodiment of the present invention.

FIG. **2** is a sectional view of a printing apparatus.

FIG. **3** is a diagram illustrating how the toner cartridge is replaced in a color laser printer with a rotary developing unit.

FIG. **4** is a flowchart illustrating a control method according to the first exemplary embodiment of the present invention.

FIG. **5** is a flowchart illustrating a control method according to the first exemplary embodiment of the present invention.

FIG. **6** is a diagram illustrating an example of a work area for managing variables.

FIG. **7** is a diagram illustrating an example of messages displayed on an operation unit or a CRT display unit.

FIG. **8** is a diagram illustrating an example of an operation screen displayed on the operation unit or the CRT display unit.

FIG. **9** is a diagram illustrating an example of the operation screen displayed on the operation unit or the CRT display unit.

FIG. **10** is a flowchart illustrating a control method according to a second embodiment of the present invention.

FIG. **11** is a flowchart illustrating a control method according to a third embodiment of the present invention.

FIG. **12** is a diagram illustrating an example of a work area for managing variables used in a fourth embodiment of the present invention.

FIG. **13** is a flowchart illustrating a control method according to the fourth embodiment of the present invention.

DESCRIPTION OF THE EMBODIMENTS

Various exemplary embodiments, features, and aspects of the invention will be described in detail below with reference to the drawings.

FIG. **1** is a block diagram illustrating a printing system according to an exemplary embodiment of the present in invention. In this printing system, a computer **100** communicates with a printing apparatus **101** through a bidirectional interface **24**. The bidirectional interface **24** may be a wired interface, such as LAN or USB, or a wireless LAN.

The computer **100** includes a central processing unit (CPU) **1**, a random access memory (RAM) **2**, a read only memory (ROM) **3**, a system bus **4**, a keyboard controller **5**, a cathode ray tube (CRT) controller **6**, a memory controller **7**, a communication unit **8**, a keyboard **9**, a CRT display **10**, and an external memory **11**.

The CPU **1** performs various kinds of data processing based on programs stored in a program ROM. The CPU **1** processes documents including graphics, images, characters, tables (such as spreadsheets) or mixtures of them. The CPU **1** collectively controls devices connected to the system bus **4**. Moreover, the CPU **1** develops outline fonts in a RAM for display information, set on the RAM **2**, and realizes WYSIWYG (What You See Is What You Get). The CPU **1** also opens various kinds of windows and executes various kinds of data processing on commands issued by the mouse cursor on the CRT display unit **10**.

The RAM **2** serves as a main memory or a work memory of the CPU **1**. The ROM **3** includes a font ROM, a program ROM, and a data ROM. The font ROM stores font data used in document processing. The program ROM stores not only a control program for controlling the computer **100** but also stores programs such as a printer selector and a network printer driver. The data ROM stores various kinds of data used in document processing.

The keyboard controller **5** controls key-in operations from the keyboard **9** and a pointing device (not illustrated). The CRT controller **6** controls display on the CRT display unit **10**.

The memory controller **7** controls access to the external memory **11**. The external memory **11** is a memory device to store a boot program, application programs, font data, user files, and edition files. The external memory **11** may be a hard disk, a flash EEPROM memory or a USB memory.

The communication unit **8** controls communication with the printing apparatus **101** through the bidirectional interface **24**.

The printing apparatus **101** includes a printer controller **102**, the operation unit **14**, the printing unit **17**, the external memory **21**, and the hard disk **23**. The printer controller **102** includes a CPU **12**, a ROM **13**, a system bus **15**, a printing unit interface **16**, a communication unit **18**, a RAM **19**, a memory controller **20**, and a disk controller **22**.

The CPU **12** executes a control program stored in the program ROM and a control program stored in the external memory **21** to perform data processing. In addition, the CPU **12**, based on the control program, collectively controls various devices connected to the system bus **15**. For example, the CPU **12** generates image data and transmits an image signal based on the image data to the printing unit **17** through the printing unit interface **16**.

The CPU **12** transmits a control signal to the printing unit **17** through the printing unit interface **16**. In addition, the CPU **12** transmits information about the printing apparatus **101** to the computer **100** through the communication unit **18**.

The ROM **13** includes the font ROM, the program ROM, and the data ROM. The font ROM stores font data used to generate image data. The program ROM stores a control program which is executed by the CPU **12**. The data ROM stores various kinds of data to be used in data processing, for example.

The operation unit **14** is an operation panel including switches and LED displays to display the key input and information. The operation unit **14** may be formed by a touch panel.

The printing unit interface **16** controls communication with the printing unit **17**. The communication unit **18** controls communication with the computer **100** performed through the bidirectional interface **24**.

The RAM **19** serves as the main memory and the work memory of the CPU **12**. The memory capacity of the RAM **19** can be expanded by adding an optional RAM to an expansion port (not illustrated). The RAM **19** can also serve as an image data memory area to store rasterized image data or an environment data memory area to store environment data or a nonvolatile RAM (NVRAM) to store various kinds of parameters.

The memory controller **20** controls access to the external memory **21**. The external memory **21**, such as an IC card or a USB memory, can store font data, an emulation program, and form data.

The disk controller **22** controls access to the hard disk **23**. The hard disk **23** stores print data and a control program, for example.

FIG. **2** is a sectional view of the printing apparatus **101**. FIG. **2** illustrates an internal structure of a color laser printer of a rotary development system. In the present exemplary embodiment, toner is used as a recording material for printing.

A scanner **711** includes a laser output unit (not illustrated) configured to convert an image signal from the printer controller **102** into a light signal (laser light), an octahedral polygon mirror **712**, a motor (not illustrated) to rotate the polygon mirror **712**, and an f/θ lens (imaging lens) **713**.

The laser beam emitted from the laser output unit is reflected from a side face of the polygon mirror **712**, passes through the f/θ lens **713** and the reflection mirror **714**, and thus scans the surface of photosensitive drum **715** linearly (raster scan). The photosensitive drum **715** rotates in the arrow direction as illustrated in FIG. **2**.

In this manner, an electrostatic latent image corresponding to an image represented by an image signal is formed on the surface of the photosensitive drum **715**. Around the photosensitive drum **715**, there are arranged a primary charging unit **717**, a whole surface exposure lamp **718**, a cleaner unit **723** to collect the toner not transferred to a paper (residual toner), and a pre-exposure charger **724**.

A developing unit **726** is a unit to develop the electrostatic latent image formed on the surface of the photosensitive drum **715**. The developing unit **726** includes the following units. The toner cartridges **730**C, **730**M, **730**Y, and **730**BK each hold toner as developer. A toner remaining amount sensor (not illustrated) is used to measure remaining toner amount of each toner cartridge.

Development sleeves **731**C, **731**M, **731**Y, and **731**BK are respectively brought into contact with the photosensitive drum **715** to develop the latent images into visible images by the developer. Screws **732** convey the developers from the toner cartridges **730**C, **730**M, **730**Y, and **730**BK respectively to the development sleeves **731**C, **731**M, **731**Y, and **731**BK. In other words, developers for cyan, magenta, yellow, and black are used to form toner images on the photosensitive drum **715**.

The toner cartridges, the development sleeves, and the screws are disposed around the central axis P. The symbols attached to the components Y, M, C and BK represent different colors. More specifically, C is cyan, M is magenta, Y is yellow, and BK is black.

A cover **701** can be opened or closed. The user can open the cover **701** and replace the toner cartridges. The toner cartridge directly below the cover **701** can be dismounted. The position directly below the cover **701** is referred to as a position for replacing toner cartridges. In FIG. **2**, the toner cartridge **730**BK is at the replacement position. Since the toner cartridges **730**Y, **730**M, **730**C, and **730**BK are rotated about the axis P, the toner cartridges move to the replacement position where they can be replaced.

A position sensor **742** detects the rotational position of a developing unit **726**. When a toner image of yellow is formed on the photosensitive drum **715**, the developing unit **726** is rotated about the axis P by a motor (not illustrated), and the photosensitive drum **715** and the developing sleeve **731**Y are brought into contact with each other.

FIG. **2** illustrates how the above-described operation is performed. To form a toner image of magenta, the developing unit **726** is rotated about the axis P by the motor, and the photosensitive drum **715** and the development sleeve **731**M are brought into contact with each other. This operation is similarly performed when toner images of cyan and black are formed.

The transfer drum **716** transfers the toner image formed on the photosensitive drum **715** onto a paper sheet. The actuator plate **719** detects the position of the transfer drum **716** moved as a result of its movement. The position sensor **720** detects, by approaching the actuator plate **719**, a fact that the transfer drum **716** has reached the home position.

There are provided the actuator plate **719**, the position sensor **720**, a transfer drum cleaner unit **725**, a paper pressing

roller **727**, a static eliminator **728**, a transfer charging unit **729**, and the transfer drum **716** around the transfer drum **716**.

The sheet cassettes **735** and **736** contain sheets of paper **791**. For example, the sheet cassette **735** contains A4-size sheets and the sheet cassette **736** contains A3-size sheets. When a sheet of paper is fed and conveyed, a paper roller **737** or **738** feeds a sheet of paper from the sheet cassette **735** or **736**.

Timing rollers **739**, **740**, and **741** are configured to control timing to supply or convey a sheet of paper. The sheet of paper passes through the timing rollers **739**, **740**, and **741**, and is guided by a paper guide **490**. Then, the paper sheet is wound around the transfer drum **716** with the leading end supported by the gripper **721**. Whether the sheet cassette **735** or **736** is selected is determined by a command from the printer controller **102**. Only the paper roller, which corresponds to the selected sheet cassette, is rotated.

By the arrangement described above, full color (C, M, Y, and BK) printing is performed.

FIG. **3** is a diagram illustrating how the toner cartridge is replaced in a laser printer with a rotary developing unit illustrated in FIG. **2**. When the user wants to replace the toner cartridge, the user opens the cover **701**.

The position directly below the opened cover **701** is the replacement position **301** for replacing a toner cartridge. The user can change the toner cartridge at the replacement position **301**. In the example of FIG. **3**, the toner cartridge **730**BK can be replaced. However, the toner cartridge replacement position is not limited to the one illustrated in FIG. **3**, but may be different according to the structure of the printing apparatus.

The motor rotates the developing unit **726** according to a control signal from the printer controller **102** to move any one of cartridges to the replacement position **301**.

A control method for the printing apparatus according to the present invention will be described. FIGS. **4** and **5** are flowcharts illustrating a control method according to an exemplary embodiment of the present invention. The control method is performed when the CPU **12** executes a program, which is stored in the ROM **13** and based on the flowcharts in FIGS. **4** and **5**.

In step S**401**, the CPU **12** determines whether to start printing. When the communication unit **18** receives print data from the computer **100**, the CPU **12** determines that printing is to be started. A case where print data is received from the computer **100** will be described below.

When print data has been received, in step S**402**, the CPU **12** sets a variable TotalPage to a total page number of print data, and sets a variable P to 1.

FIG. **6** illustrates an example of a work area to manage variables to be used in the control method. The values of the variables are stored in the RAM **19**.

The variable TotalPage indicates a total number of pages to be printed. The P denotes a page number under processing. The variable CoverOpen indicates whether the cover **701** has been opened or closed. If the cover **701** has not been opened or closed, 0 (zero) is set. If the cover **701** has been opened or closed, 1 is set. The initial value (default) is 0.

A variable CRG_OUT serves as a toner-out flag for each toner cartridge. If a toner cartridge is not determined as toner-out, the toner-out flag is set to 0. When the toner cartridge is determined as toner-out, the flag is set to 1. The default value is 0.

A variable CRG_OVERRIDE serves as a continued use flag for each toner cartridge. The continued use means that even when a toner cartridge has been determined as toner out, the user selects continued use.

Even when a remaining toner amount sensor detects that the toner cartridge is empty, there may be cases where some toner remains in the toner cartridge. In such a case, the user can still use that small amount of toner by "continued use." If the user does not select continued use, 0 is set in the above variable. If the user selects continued use, 1 is set. The default value is 0.

A variable CRG_CHANGE indicates whether each toner cartridge has been replaced. If the toner cartridge has not been replaced, 0 is set. If the toner cartridge has been replaced, 1 is set. The default value is 0.

In step S**403**, the CPU **12** acquires status information from the printing unit **17**. The status information includes CRG status indicating the remaining amount of toner in each toner cartridge. The CPU **12** can detect a toner low state and a toner-out state based on the CRG status.

In step S**404**, the CPU **12** sets the variable n to 1. In step S**405**, the CPU **12** determines whether the value of the variable is larger than 4. If the variable n is equal to or smaller than 4 (NO in step S**405**), in step S**406**, the CPU **12** determines whether the n-th toner cartridge is out of toner, according to the status information acquired in step S**403**. In the example of FIG. **4**, the toner cartridge **730**C is the first one, the toner cartridge **730**M is the second one, the toner cartridge **730**Y is the third one, and the toner cartridge **730**BK is the fourth one.

If the n-th toner cartridge is in the toner out state, in step S**407**, the CPU **12** sets the variable CRG_OUT [n] to 1. In step S**408**, the CPU **12** increments the variable n by 1, and the processing proceeds to step S**405**.

If the variable n is larger than 4 (YES in step S**405**), in step S**409**, the CPU **12** sets a variable m to 1. In step S**410**, the CPU **12** determines whether the value of the variable m is larger than 4. If the variable m is equal to or smaller than 4 (NO in step S**410**), in step S**411**, the CPU **12** determines whether the value of CRG_OUT[m] is 1 or not. In other words, the CPU **12** determines whether the m-th toner cartridge has been determined as toner-out.

If CRG_OUT [m] is 1 (YES in step S**411**), in step S**412**, the CPU **12** determines whether the value of CRG_OVERRIDE [m] is 1. In other words, the CPU determines whether continued use of the m-th toner cartridge has already been selected. If the value of CRG_OVERRIDE [m] is 1 (YES in step S**412**), the m-th toner cartridge is not replaced. Therefore, the m-th toner cartridge is not moved to the replacement position.

If the value of CRG_OVERRIDE [m] is not 1 (NO in step S**412**), in step S**413**, the CPU **12** instructs the printing unit **17** to move the m-th toner cartridge to the replacement position. In response to this instruction, the motor in the printing unit **17** moves the m-th toner cartridge to the replacement position.

In step S**413**, the CPU **12** displays a message on the operation unit prompting that the m-th toner cartridge should be replaced with a new one. Alternatively, through the communication unit **18**, the CPU **12** sends to the computer **100** status information notifying that the m-th toner cartridge is out of toner. The computer **100** displays on the display unit **10** a message indicating that the m-th toner cartridge needs to be replaced.

FIG. **7** is an example message displayed on an operation unit **14** or a CRT display unit **10**. In the example of FIG. **7**, a message is displayed indicating that a toner cartridge of black needs to be replaced. The message may inform that the toner cartridge has run out of toner.

Together with the display of a message about necessity of toner cartridge replacement, the operation unit **14** or the CRT display unit **10** displays a button **800** for the user to instruct

the continued use of the toner cartridge. The computer **100** notifies the printing apparatus **101** whether the button **800** has been pressed.

There may be cases where printed characters or graphics may be too thin and blurred even though the toner cartridge is used continuously, because the toner remains little or has been consumed complexly. Therefore, the printing apparatus **101** inquires the user if the user is still to make continued use of the toner cartridge.

In step S**414**, the CPU **12** determines whether the button **800** provided to select continued use has been pressed. If the button **800** has been pressed (YES in step S**414**), in step S**415**, the CPU **12** sets CRG_OVERRIDE to 1 for each of one or more toner cartridges whose CRG_OUT is 1. For example, when CRG_OUT[**1**] and CRG_OUT[**4**] are 1, CRG_OVERRRIDE[**1**] and CRG_OVRERRIDE[**4**] are set to 1.

In the example of FIG. **5**, the user, by a single operation, can select continued use of two or more toner cartridges which have become toner out at the same time. However, the user may separately set continued use for each of two or more toner cartridges that have become toner out at the same time. In this case, after step S**415**, the processing proceeds to step S**419**.

If the button **800** is not pressed (NO in step S**414**), in step S**416**, the CPU **12** determines whether the cover **701** has been opened or closed. If the cover **701** has been opened or closed (YES in step S**416**), in step S**417**, the CPU **12** sets the variable CoverOpen to 1 and, in step S**418**, sets CRG_CHANGE [m] to 1. In the present exemplary embodiment, by detecting the cover **701** being opened or closed, the CPU **12** determines that the toner cartridge has been changed.

In step S**419**, the CPU **12** increments the value of the variable m by 1, and the processing proceeds to step S**410**.

If the variable m is larger than 4 (YES in step S**410**), in step S**420**, the CPU **12** determines whether the variable CoverOpen is 1.

If the variable CoverOpen is not 1 (NO in step S**420**), in step S**421**, the CPU **12** determines whether the value of the variable P is larger than the value of the variable TotalPage. If the value of the variable P is larger than the value of the variable TotalPage (YES in step S**421**), this means that all pages have been printed, and the processing proceeds to step S**401**.

If the value of the variable P is equal to or smaller than the value of the variable TotalPage (NO in step S**421**), the CPU **12** sends to the printing unit **17** image data of a page number represented by the variable P, in step S**422**, and the printing unit **17** prints a page of the page number represented by the variable P. In step S**423**, the CPU **12** increments the variable P by 1 and the processing proceeds to step S**403**.

If the value of the variable CoverOpen is 1 (YES in step S**420**), in step S**424**, the CPU **12** instructs the printing unit **17** to perform initialization processing to enable the newly-installed toner cartridge to be used. In step S**424**, the CPU **12** sets the variable CoverOpen to 0.

In step S**425**, the CPU **12** sets a variable s to 1. In step S**426**, the CPU **12** determines whether the value s is larger than 4. If the value of the variable s is larger than 4 (YES in step S**426**), the processing proceeds to step S**402**. If the value of the variable s equal to of smaller than 4 (No in step S**426**), in step S**427**, the CPU **12** determines whether the value of CRG_CHANGE[s] is 1.

If the value of CRG_CHANGE [s] is 1 (YES in step S**427**), in step S**428**, the CPU **12** sets CRG_OUT[s] to 0, and sets CRG_CHANGE[s] to 0.

In step S**429**, the CPU **12** increments the variable s by 1 and the processing proceeds to step S**426**.

According to the control method illustrated in FIGS. **4** and **5**, the toner cartridge specified for continued use is not to be a target of replacement thereafter, and the toner cartridge is not to be moved to the replacement position in step S**413**.

When the user intends to replace the toner cartridge specified for continued use, the user have to separately issue an instruction to replace the toner cartridge. FIG. **8** illustrates an example of an operation screen displayed on the operation unit **14** or the CRT display unit **10**. From among the buttons **801** to **804**, the user presses a button corresponding to a toner cartridge the user intends to replace.

When the user presses a button on the operation screen displayed on the CRT display unit **10**, the computer **100** notifies the printing apparatus **101** of an instruction to replace a toner cartridge and the toner cartridge selected by the user.

The CPU **12** instructs the printing unit **17** to move the toner cartridge selected by the user to the replacement position. In response to the instruction, the motor in the printing unit **17** moves the toner cartridge selected by the user to the replacement position. Then, the CPU **12** determines whether the cover **701** has been opened or closed. If the cover **701** has been opened or closed, the CPU **12** sets CRG_OUT corresponding to the toner cartridge selected by the user to 0. Then, the CPU **12** sets CRG_OVERRIDE corresponding to the toner cartridge selected by the user to 0.

In the exemplary embodiment in FIG. **5**, the toner cartridge specified for continued use is not to be a target of replacement thereafter, and is not to be moved to the replacement position in step S**413**. However, there may be some users who want to replace the toner cartridge specified for continued use at a timing when another toner cartridge runs out of toner, together therewith.

For this reason, according to a second exemplary embodiment of the present invention, a user can previously select whether to move the toner cartridge specified for continued use to the replacement position when another toner cartridge runs out of toner.

FIG. **9** illustrates an example of an operation screen displayed on the operation unit **14** or the CRT display unit **10**. When the user desires that the toner cartridge specified for continued use should be moved to the replacement position in a case where another toner cartridge runs out of toner, the user ticks a check box **901** and presses an OK button **902**. If the user desires that the toner cartridge specified for continued use should not be moved to the replacement position, the user presses the OK button **902** without ticking the check box **901**.

The CPU **12** sets the variable AUTO to 1 when a check mark is input in the check box **901**, and sets the variable AUTO to 0 when a check mark is not input in the Check box **901**. The value of the variable AUTO is stored in the external memory **21** or the hard disk **23**.

FIG. **10** is a flowchart illustrating a control method according to the second exemplary embodiment. This control method is performed when the CPU **12** executes a program, which is stored in the ROM **13** and based on the flowchart in FIG. **10**. In FIG. **10**, steps S**1001** and S**1002** are newly added. The flowchart in FIG. **10** will be described focusing on differences from the flowchart in FIG. **4**.

In step S**412**, the CPU **12** determines whether the value of CRG_OVERRIDE [m] is 1. If the value of CRG_OVERRIDE is 1 (YES in step S**412**), in step S**1001**, the CPU **12** determines whether the value of the variable AUTO is 1.

If the value of the variable AUTO is 1, the CPU **12** refers to CRG_OUT[**1**] through CRG_OUT[**4**], and CRG_OVERRIDE[**1**] through CRG_OVERRIDE[**4**]. In step S**1002**, the CPU **12** determines whether there is another toner cartridge including CRG_OUT having the value of 1 and CRG_OVER-

RIDE having the value of 0. If there is another toner cartridge (YES in step S**1002**), in step S**413**, the CPU **12** moves the m-th toner cartridge to the replacement position.

According to the second exemplary embodiment, the user can select whether to move the toner cartridge specified for continued use to the replacement position when another toner cartridge runs out of toner.

According to the second exemplary embodiment, it is determined whether to move the toner cartridge specified for continued use to the replacement position when another toner cartridge runs out of toner. In a third exemplary embodiment of the present invention, it is determined whether to move the toner cartridge specified for continued use to the replacement position when another toner cartridge is replaced.

FIG. **11** is a flowchart illustrating a control method according to the third exemplary embodiment. This control method is implemented when the CPU **12** executes a program, which is stored in the ROM **13** and based on the flowchart in FIG. **11**. In FIG. **11**, steps S**1101** and S**1102** are added. The flowchart in FIG. **11** will be described focusing on differences from the flowchart in FIG. **4**.

In step S**412**, the CPU **12** determines whether the value of CRG_OVERRIDE[m] is 1. If the value of CRG_OVERRIDE [m] is 1 (YES in step S**412**), in step S**1101**, the CPU **12** determines whether the value of the variable AUTO is 1.

If the value of the variable AUTO is 1 (YES in step S**1101**), in step S**1102**, the CPU **12** determines whether the value of the variable CoverOpen is 1. If the value of the variable CoverOpen is 1 (YES in step S**1102**), in step S**413**, the CPU **12** moves the m-th toner cartridge to the replacement position.

According to the third exemplary embodiment, the user can select whether to move the toner cartridge specified for continued use to the replacement position when another toner cartridge is replaced.

According to a fourth exemplary embodiment, after continued use of a toner cartridge is specified and then a predetermined number of pages are printed, a toner cartridge specified for continued use is moved to the replacement position. In the fourth exemplary embodiment, two variables are provided, namely, a variable CRG_PrintPage representing a number of pages printed by using toner cartridges and a variable CRG_OVERRIDEPage representing a number of pages when continued use of a toner cartridge is specified.

FIG. **12** is a diagram illustrating an example of a work area in which variables used in the fourth exemplary embodiment are managed. Those values of the variables are stored in the external memory **21** or the hard disk **23**. In the example of FIG. **12**, the number of pages printed by using the toner cartridge **730**C is 100. The number of pages printed by using the toner cartridge **730**BK is 200. When the number of pages printed by the toner cartridge **730**BK was 150, continued use of the toner cartridge **730**BK was specified.

FIG. **13** is a flowchart illustrating a control method according to the fourth exemplary embodiment. The control method is implemented when the CPU **12** executes a program, which is stored in the ROM **13** and based on the flowchart of FIG. **13**. In FIG. **13**, steps S**1301** through S**1304** are added. The flowchart in FIG. **13** will be described focusing on differences from the flowchart in FIG. **4**.

After executing step S**422**, in step S**1301**, the CPU **12** increments by 1 the value of CRG_PrintPage corresponding to one or more toner cartridges used in printing in step S**422**. For example, when the toner cartridge **730**BK is used, the CPU increments the value of CRG_PrintPage[**4**] by 1.

After executing step S**415**, in step S**1302**, the CPU **12** sets the value of CRG_PrintPage into CRG_OVERRIDEPage with regard to one or more toner cartridges which has been set in step S**415**. For example, when continued use of the toner cartridge of cyan and the toner cartridge of black is specified, the CPU **12** sets the value of CRG_PrintPage [**1**]_into CRG_OVERRIDEPage [**1**]. Furthermore, the CPU **12** sets the value of CRG_PrintPage[**4**] into CRG_OVERRIDEPage [**4**].

If the value of CRG_OVERRIDE [m] is 1 (YES in step S**412**), in step S**1303**, the CPU **12** determines whether the value of CRG_PrintPage[m] is larger than the value of CRG_OVERRIDEPage[m] with a predetermined value added. In the example of FIG. **13**, the predetermined value is 300.

If the value of CRG_PrintPage[m] is larger than the value of CRG_OVERRIDEPage[m] with the predetermined value added (YES in step S**1303**), the processing proceeds to step S**413**. If the value of CRG_PrintPage[m] is equal to or smaller than the value of CRG_OVERRIDEPage[m] with the predetermined value added (NO in step S**1303**), the processing proceeds to step S**419**.

After executing step S**428**, in step S**1304**, the CPU **12** sets 0 into each of CRG_PrintPage[s] and CRG_OVERRIDEPage[s].

According to the fourth exemplary embodiment, even when continued use of the toner cartridge has been specified, after a predetermined number of pages are printed, the toner cartridge is moved to the replacement position.

A printing apparatus according to the present invention is not limited to the laser beam printer, but may be printing apparatuses of other printing systems. Though the toner-type printing apparatus has been described above, the present invention can be applied to printing apparatuses using printing materials, such as ink or toner.

Moving a storing unit configured to store a recording material to a position where the recording material is supplied to the printing apparatus includes moving a toner cartridge, an ink cartridge or an ink tank to a position where they can be replaced with new ones. The above expression further includes moving the toner cartridge to a position where the toner cartridge can be refilled with the toner and moving the ink cartridge to a position where the ink cartridge can be refilled with the ink.

In the above-described exemplary embodiments, the CPU **12** executes the program based on the flowcharts in FIGS. **4**, **5**, **10**, **11**, and **13**. However, instead of the CPU **12**, a control circuit may be used, which is designed to execute a control method based on the flowcharts in FIGS. **4**, **5**, **10**, **11**, and **12**.

According to the present invention, the user can select whether to move a storing unit determined to have run out of a recording material to a position where the recording material can be supplied. The printing apparatus can select whether to move the storing unit determined to have run out of the recording material to the position where the recording material can be supplied.

Aspects of the present invention can also be realized by a computer of a system or apparatus (or devices such as a CPU or MPU) that reads out and executes a program recorded on a memory device to perform the functions of the above-described embodiments, and by a method, the steps of which are performed by a computer of a system or apparatus by, for example, reading out and executing a program recorded on a memory device to perform the functions of the above-described embodiments. For this purpose, the program is provided to the computer for example via a network or from a recording medium of various types serving as the memory device (e.g., computer-readable medium). In such a case, the

system or apparatus, and the recording medium where the program is stored, are included as being within the scope of the present invention.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all modifications, equivalent structures, and functions.

This application claims priority from Japanese Patent Application No. 2011-159012 filed Jul. 20, 2011, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. A printing apparatus configured to perform printing by using a recording materiel, comprising:

a storing unit configured to store recording material;

a moving unit configured to move a storing unit determined to run low on or run out of a recording material to a position where a recording material is supplied to the printing apparatus; and

a setting unit configured to, according to an instruction from a user, set continued use of the storing unit determined to run low on or run out of the recording material,

wherein the moving unit does not move the storing unit to the position even when the storing unit is determined to run low or run out of the recording material if continued use of the storing unit determined to run low on or run out of the recording material is set.

2. The printing apparatus according to claim **1**, wherein the moving unit moves the storing unit to the position according to an instruction to move the storing unit to the position even if continued use of the storing unit determined to run low on or run out of the recording material is set.

3. The printing apparatus according to claim **1**, further comprising:

a selecting unit configured to select whether to move a first storing unit determined to run low on or run out of the recording material to the position when a second storing unit different from the first storing unit is determined to run low on or run out of the recording material,

wherein when moving the first storing unit to the position is selected and the second storing unit is determined to run low on or run out of the recording material, the moving unit moves both the first storing unit and the second storing unit to the position.

4. The printing apparatus according to claim **3**, wherein when moving the first storing unit to the position is not selected and the second storing unit is determined to run low on or run out of the recording material, the moving unit does not move the first storing unit to the position, but moves the second storing unit to the position.

5. The printing apparatus according to claim **1**, wherein after continued use of the storing unit determined to run low on or run out of the recording material is set, when a number of pages printed by using the storing unit reaches a predetermined number, the moving unit moves the storing unit to the position.

6. The printing apparatus according to claim **1**, wherein the recording material is toner and the storing unit is a toner cartridge.

7. The printing apparatus according to claim **1**, wherein the moving unit rotates a plurality of storing units and moves a storing unit determined to run low on or run out of the recording material to the position.

8. The printing apparatus according to claim **1**, wherein supplying the recording material to the printing apparatus includes replacing the storing unit.

9. The printing apparatus according to claim **1**, wherein supplying the recording material to the printing apparatus includes refilling the storing unit with the recording material.

10. The printing apparatus according to claim **1**, wherein the position where the recording material is supplied to the printing apparatus is a position corresponding to an opening or closing of a cover.

11. The printing apparatus according to claim **1**, further comprising a memory unit configured to store information indicating whether each of a plurality of storing units is determined to run low on or run out of the recording material and information indicating whether to continue to use each of the plurality of storing units.

12. The printing apparatus according to claim **1**, further comprising:

a receiving unit configured to receive the instruction from the user through an external computer.

13. The Printing apparatus according to claim **1**, wherein the moving unit moves the storing unit determined to run low on or run old of the recording material, according to a determination that the storing unit runs low on or runs out of the recording material.

14. The printing apparatus according to claim **13**, wherein, after printing is started, the moving unit moves the storing unit determined to run low on or run out of the recording material, according to the determination that the storing unit runs low on or runs out of the recording material.

15. The printing apparatus according to claim **1**, wherein the moving unit moves the storing unit to the position according to a determination that another storing unit runs low on or runs out of recording material even if continued use of the storing unit is set.

16. A control method for controlling a printing apparatus that performs printing by using a recording material stored in a storing unit, comprising:

moving the storing unit determined to run low on or run out of the recording material to a position where a recording material is supplied to the printing apparatus; and

setting, according to an instruction from a user, continued use of the storing unit determined to run low on or run out of the recording material,

wherein the storing unit is not moved to the position even when the storing unit is determined to run low on or run out of the recording material if continued use of the storing unit determined to run low or run out of the recording material is set.

17. A non-transitory computer readable storage medium storing computer-readable instructions causing a computer of a printing apparatus that includes a storing unit configured to store a recording material and performs printing by using the recording material, to execute a method, the method comprising:

moving a storing unit determined to run low on or run out of the recording material to a position where a recording material is supplied to the printing apparatus; and

setting, according to an instruction from a user, continued use of the storing unit determined to run low on or run out of the recording material,

wherein the storing unit is not moved to the position even when the storing unit is determined to run low or run out of the recording material, if continued use of the storing unit determined to run low on or run out of the recording material is set.

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